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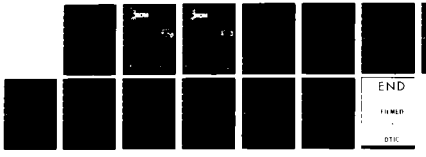

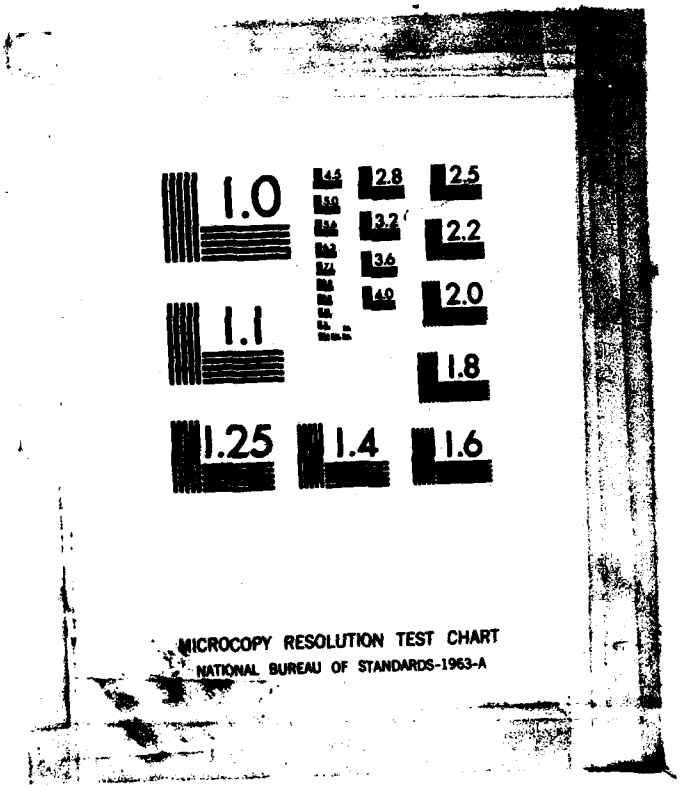
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THE BDM CORPORATION

INTEGRATED NUCLEAR AND CONVENTIONAL THEATER WARFARE SIMULATION (INWARS) DOCUMENTATION

PART IV

USER'S MANUAL COMPONENT

VOLUME I

INTRODUCTION

THE BDM CORPORATION

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February 8, 1980

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FOREWORD

This is Volume I of the User's Manual Component of the Interpreted Nuclear and Conventional Theater Warfare Simulation (INWARS) documentation. It introduces the User's Manual Component by reviewing the utilization of INWARS and surveying the inputs and outputs of the simulation.

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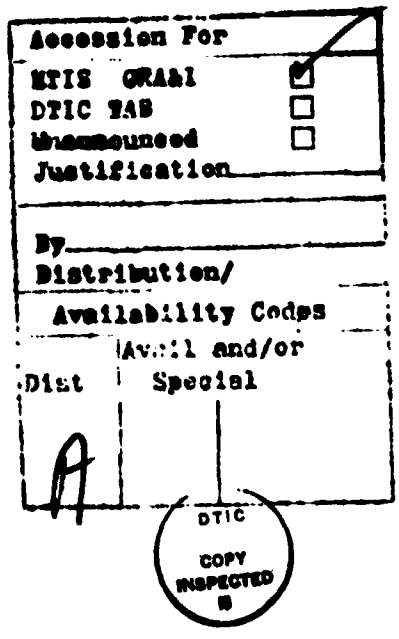

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CHAPTER I
INTRODUCTION TO THE USER'S MANUAL

A. INTRODUCTION

This volume introduces the User's Manual component of the overall INWARS documentation. In this component, the emphasis will be on the use of the simulation which has been described in the Modeling Description and Software Description components of the documentation. Thus, concern centers here on the formats in which inputs are provided to the simulation, and the types of outputs produced by the simulation as it runs.

B. UTILIZATION OF INWARS

To provide some orientation towards the use of INWARS, this section reviews the two potential modes of application discussed in the Synopsis component of the documentation. As was emphasized there, INWARS should not be regarded as predictive of what would "really happen" in a theater level conflict situation. Rather, it should be regarded as a tool which analysts can use in investigations of various problems and issues, perhaps in conjunction with other tools, but always in conjunction with their own judgement. To the extent that INWARS meets its development objectives, it is not a general purpose model, but is rather better suited to some types of problems and issues than others. Given the emphasis of scope over resolution, INWARS itself is not, for example, well-suited for evaluation of alternative major systems (e.g., Tank A versus Tank B). Based on the development objectives, two principal analytical roles for INWARS application may be identified: INWARS as a doctrine-policy simulator, and INWARS as a scenario generator. The first of these utilizes INWARS by itself, while the second uses INWARS in conjunction with other, more detailed, simulations.

1. INWARS as a Doctrine-Policy Simulation

Consistent with its development objectives, INWARS has been designed to allow the user to specify -- via input data - a large portion of the doctrines, policies, constraints, and standard operating procedures by which the simulated force elements are to operate. These include, in particular, concepts of operation to guide the planning and execution of ground operations, weapons-employment concepts and constraints to guide the utilization of conventional, nuclear, and chemical weapons, and threat response policies, to guide the adaption of ongoing operations to changes in perceived nuclear and chemical threat. INWARS C^2I elements at echelons above division apply these doctrines and policies during the simulation by selectively "fitting" them to the (perceived) situations they face as they plan operations, consider weapons employment, and respond to nuclear and chemical threats. Thus, the actions of INWARS force elements reflect the user-input doctrines and policies as applied in the specific situations which arise in the course of the simulated conflict. Consequently, the course of the simulated conflict represents the interactions among the doctrines and policies of the opposing forces.

To utilize INWARS in this doctrine-policy simulation role, an initial configuration of force elements with specific distribution of assets (major systems, etc.) would be postulated. Likewise, broad goals for the opposing theaters would be postulated. Finally, a range of alternative systems of doctrines and policies would be postulated, for one or both sides. A set of simulation runs would then be conducted, one for each of the alternative doctrine-policy systems under consideration. By comparing the evolution and outcomes of the resulting simulated conflicts, insights could be gained into impacts of the differeing doctrines and policies. Of course, even here, the analysis must be tempered by the fact that the simulated C^2I elements are quite "doctrinaire": they cannot creatively develop "new" doctrines and policies as a real commander might.

2. INWARS as a Scenario Generator

As INWARS is run and the theater-level conflict situation evolves, various situations may arise which are of interest for more detailed analysis. The entity-based architecture of INWARS enables these situations to be taken from INWARS, mapped out, and used as a basis for inputs to corresponding more detailed models. In this sense, INWARS can be used as a "scenario-generator" for more detailed models. Thus, for example, while INWARS itself is not well suited for detailed comparative evaluation of alternative major systems, it may be used to generate specific combat situations in which to evaluate the alternative systems with more detailed models. Moreover, since the situations generated are dependent on the user-specified doctrines and policies, the role of the alternative systems under different broad forms of operation may, to an extent, be explored.

C. PREVIEW OF THE USER'S MANUAL

Over the remainder of this introductory volume, INWARS inputs and outputs will be surveyed. Detailed descriptions of inputs and their formats are then provided in Volumes II and III; Volume II concerns the inputs needed by Combat Interactions Procedures while Volume III concerns those used by Command, Control, and Intelligence (C^2I) Procedures. Finally, Volume IV describes the forms of output produced by INWARS.

CHAPTER II
INWARS INPUTS

A. INTRODUCTION

In this chapter, the types of inputs required by INWARS will be surveyed. The range of information ultimately required in an INWARS run may be partitioned into five broad categories: (1) environmental information, (2) Order of Battle (OB) information, (3) performance information, (4) doctrine, policy, and procedure information, and (5) campaign information. Environmental information characterizes the physical context in which the conflicting forces interact; it is discussed in Section B below. Order of Battle (OB) Information characterizes the forces in conflict in terms of composition, disposition, strength, tactics, and other OB-related information (see Section C). Performance information characterizes the abilities of the force elements in carrying out their functions and interacting with other friendly and/or enemy force elements (see Section D). Doctrine, policy, and procedure information characterizes the inference and decisionmaking processes of C^2I elements at Echelons Above Division (EAD). This is a very important category in view of the INWARS focus on EAD C^2I elements; it is discussed in Section E. Finally, campaign information characterizes the overall campaign objectives, operating constraints (if any) and initial configuration of each force in the conflict (see Section F).

B. ENVIRONMENTAL INFORMATION INPUTS

Environmental information characterizes the physical context in which individual force elements operate and interact. This information will consist largely of terrain information appropriate to many different uses of the model; thus, once developed, most environmental information should require little modification or redevelopment.

INWARS decomposes the theater geography into contiguous hexagonal regions having a "diameter" (across faces) of 9.45 kilometers. Each hex is characterized not only in terms of its relative position, but also in terms of such terrain attributes as terrain type, barriers, rivers, nationality, population density, nuclear and chemical terrain effects, and so on. For the purposes of specifying INWARS inputs, terrain information can be characterized in terms of hex attributes in the general area of operations. Details on the attributes included and formats for their specification will be found in the User's Manual, Volume II, Section K.

C. ORDER OF BATTLE INFORMATION INPUTS

Because of the entity-based architecture of INWARS, a large portion of the input information is structured around individual force elements; such information generally reflects characteristics and capabilities of force elements in a direct fashion. For this reason, such data can be conveniently characterized and specified in Order of Battle (OB) terms and categories. These include: (1) composition information (Section 1), (2) strength information (Section 2), (3) disposition information (Section 3), and (4) tactics information (Section 4).

1. Composition Information Inputs

As an OB category, composition information concerns the identification and organization of specific units and commands. Each force element to be included in an INWARS run must be identified in terms of: (1) a unit identity, (2) a side (NATO vs. Warsaw Pact), (3) a nationality, (4) an echelon of command, and, (5) a unit type classification (e.g., C^2I element, maneuver brigade/regiment, or air base cluster). In addition to unit identification, organizational information must also be included in INWARS inputs. This amounts to a specification to the chain of command among the various force elements. The manner in which such inputs are made is discussed in the User's Manual, Volume II, Sections E and L (especially L.1).

2. Strength Information Inputs

As an OB category, strength information refers to the quantities of material and men possessed by a unit or command. For the purposes of INWARS inputs, the strength information category is used analogously. Each force element introduced into the simulation must be endowed with (initial) quantities of assets. Of course, before unit strength can be specified, the types of assets to be treated in the simulation must be established and characterized. While it is not expected that the user would make frequent changes to the asset typing scheme, INWARS does permit such changes to be made via data.

The range of asset types to be treated in INWARS would typically include major weapons systems, supplies and so on, but would exclude such equipment as individual weapons, communications equipment, and other assets whose functions are only treated implicitly in INWARS. Potentially significant reductions in run-time and storage will accrue to a limited and highly aggregated range of asset types (e.g, consisting of few distinct asset types). Limitations and aggregations in this area also appear to be consistent with the overall objectives of INWARS. Within the simulation, each asset type is essentially defined by a block of parameters which characterize how assets of that type operate and perform under varying conditions. These include, for example, attrition rates, suppression parameters, vulnerabilities, and so on, as discussed in the User's Manual, Volume II, Section F.

Once an asset typing scheme has been specified, unit strength information can be specified as an initial state variable value by simply indicating the quantity of each asset type possessed by the unit (as described in the User's Manual, Volume II, Section L (especially L.3)).

3. Disposition Information Inputs

As an OB information category, disposition information refers to the location of force elements and their tactical deployment. For the purposes of specifying INWARS inputs, disposition information is thus the category under which force elements are "placed" on the ground. Each force

element introduced must ultimately be assigned a particular hex address within the overall hexagonal decomposition of the terrain. In addition to locating force elements in the hex address system, disposition specifications must also characterize their tactical deployment in terms of "facing" within the hex they occupy, their initial operating objective, sector responsibilities and so on. (See the User's Manual, Volume II, Section L, especially L.2 and L.5).

4. Tactics Information Inputs

As an OB information category, tactics information concerns tactical doctrine (accepted principles of organization and employment of forces for the conduct of operations) as well as tactics employed by specific units (manner in which the units conduct operations). For the purposes of specifying INWARS inputs, tactics information is the category under which lower-echelon force elements (divisions and below) are provided with limited capabilities to conduct operations and react to the situations they face. (Because of the INWARS focus on higher-echelon EAD C^2I processes, corps and above must be endowed with more extensive inference and decisionmaking capabilities, specified as discussed in Section E, below).

To specify tactics information, the range of permissible operation types must first be determined. Each operation type must first be characterized in terms of its effects on combat processes and force element interactions. The tactical relationships among operation types and situation perceptions must then be characterized in the form of Operation Reaction Systems (ORS's) to guide the various types of force elements. As with asset types, it is expected that operation types (and the related definitional data) will not be changed frequently; again, however, INWARS permits such changes via data input.

a. Range of Operation Types to be Treated

The basic determination of which operation types should be treated in INWARS must insure that enough different operations are treated to adequately represent the operations of all force elements (i.e., C^2I elements as well as maneuver brigades and regiments, and NATO as well as

Warsaw Pact force elements). More operations "cost" more in terms of storage requirements, but do not cause extensive increases in run-time. On the other hand, there is little to be gained by adding operations which cannot be distinguished in terms of their defining physical parameters or operational reactions.

b. Specifying Operation Effects on Combat Processes and Force Interactions

One basic role of operations in INWARS is to provide an operational context for physical combat processes and force interactions. They do this by supplying operation-dependent parameters to the various process and interaction representations. For example, vulnerabilities to various forms of attack (e.g., with nuclear weapons) may depend on a force element's type of operation. Operations are thus "defined", at least in part, by the parameters they supply. The parameters are input as described in the User's Manual, Volume II, Section I.

c. Specifying Operation Reaction Systems

The other basic role of operations in INWARS is to provide an operational context for reactions of units to the situations they face. The mechanism for this is the units' Operation Reaction Systems (ORS's). ORS inputs are described in the User's Manual, Volume II, Section H (see also Section J); a particular force element may be assigned to use a particular ORS as described in the same volume, Section L (see especially L.4, L.5, and L.6).

D. PERFORMANCE INFORMATION INPUTS

Performance information concerns the abilities of force elements to perform the functions associated with their basic type. This may or may not involve their interactions with the environment or with other force elements. Of course, a great deal of performance information is included in the specification of asset types, operation types, and Operation Reaction Systems. Three other notable categories include information collection parameters, search pattern data, and nuclear/chemical readiness parameters. These are discussed in the User's Manual, Volume II, Sections C, D, and G, respectively.

E. DOCTRINE, POLICY, AND PROCEDURE INFORMATION

The fourth major category of INWARS input information concerns the operating doctrines, policies, and procedures which govern the behavior of force elements at Echelons Above Division (EAD). Since the EAD C^2I processes are the principal focus of INWARS, this information category includes a wide variety of information elements; this is especially true in view of the C^2I design which attempts to define C^2I behavior through data rather than code. The inputs in this area are used to construct the Understandings of the Situation (UOS's) by which EAD C^2I elements operate, and may be considered in two broad categories: (1) Fundamental Knowledge Information, and (2) UOS Specification Information.

1. Fundamental Knowledge Information Inputs

The basic doctrines and policies by which INWARS EAD C^2I elements operate are contained in the Fundamental Knowledge component of their UOS's. This Fundamental Knowledge does not change over the course of a single run in INWARS. However, given the focus on EAD C^2I processes, it is expected that doctrines and policies may be varied between runs as suggested in Chapter I, Section B, above. The types of information included in these inputs are Concept Information, Analysis Parameters, and Procedural Information.

a. Concept Information Inputs

Perhaps the most unique category of EAD C^2I input information relates to guiding concepts -- concepts of operation and concepts of weapons employment. INWARS EAD C^2I process representations embody a "concept-guided" approach. The user supplies the model with certain abstract guidance ("concepts") concerning the generic forms of alternatives to consider in specific decisionmaking contexts (e.g., development of ground operations or consideration of nuclear weapons employment). Through a sequence of specification and refinement steps, the model itself is capable of "fitting" any of these abstract concepts to the particulars of a given EAD C^2I element's situation.

Concepts of operation guide the operations development process. A concept of operation in INWARS is characterized by: (1) suitability requirements; (2) a set of thresholds, operating standards, and

other parameters characterizing the operation; and, (3) an (abstract) "operation form" specifying who should be doing what at any given time. Each EAD C^2I element in INWARS must be provided access to lists of offensive and defensive concepts of operation, ordered in terms of doctrinal preference. Concepts of operation inputs are described in the User's Manual, Volume III, Chapter II, Section C.

Weapons employment is also a concept-guided process in INWARS. Here, however, the "abstract guidance" provided by the user consists of sets of "weapons employment concepts" concerning which types of enemy force elements should be targeted and what effects should be inflicted on them. As with concepts of operation, each EAD C^2I element must be provided access to a set of such concepts for each type of weapons ordered by doctrinal preference. Weapons employment concept inputs are discussed in the User's Manual, Volume III, Chapter II, Section D.

b. Analysis Parameter Inputs

As a part of their inference and decisionmaking activities, EAD C^2I elements in INWARS have occasion to undertake a variety of "analyses". Examples include the estimation of subordinate progress or the updating of the nuclear threat index in response to nuclear indicators. Such analyses are often conducted with the aid of various parameters (i.e., expected advance rates, force balance adjustment factors, and indicator likelihood ratios). Certain of these parameters are input as a part of Standard Operating Procedures (SOP) data; others relating strictly to the employment of weapons are input as Weapons Parameters. These are discussed in the User's Manual, Volume III, Chapter II, Sections A and E, respectively.

c. Procedural Information Inputs

EAD C^2I element inference and decisionmaking activities are generally broken up into smaller "C^2I tasks" within the model. During the performance of a given task, other derivative tasks may be indicated. As an example, during the interpretation of a unit intelligence message, it may become apparent that force balance should be recomputed (due, e.g., to a "significant change" in perceived enemy strength). To a limited extent,

INWARS gives the user control over these procedural links among C^2I tasks. In the example, user-supplied data establishes thresholds of significance for changes in strength and other information elements; it also determines which potential future tasks will be flagged as derivative actions to be undertaken upon recognition of a "significant" change. This information is input as the "Updating Thresholds and Flags" data described in the User's Manual, Volume III, Chapter II, Section B.

2. UOS Specification Inputs

Beyond the fundamental knowledge inputs, certain information specific to particular EAD forces must be input to complete the specification of the UOS's. This includes the identities of supporting force elements (e.g., air support and nuclear or chemical weapons delivery support), initial characterization of subordinate force element roles and reserve relationships (if any), initial nuclear/chemical readiness, and nuclear and chemical weapons initially authorized for employment (if any). These inputs are described in the User's Manual, Volume III, Chapter III.

F. CAMPAIGN INFORMATION INPUTS

Up to this point, the inputs have characterized the conflict environment, the forces in conflict, their performance, and the doctrines, policies, and procedures by which they will operate. All that remains is to specify the campaign information -- objectives as well as guidelines and constraints, if any - which will "drive" the conflicting forces. Of this information, objectives are the most significant. Guidelines on resources availabilities and constraints on, e.g., nuclear or chemical weapons employment must also be included as a part of the campaign information. This information is input as described in the User's Manual, Volume III, Chapter IV.

CHAPTER III
INWARS OUTPUTS

A. INTRODUCTION

In this chapter, the outputs produced during an INWARS run will be surveyed. These outputs are of two basic types: (1) physical state snapshots, and (2) EAD C^2I Element Understanding of the Situation (UOS) snapshots. These outputs are discussed briefly in Sections B and C, below. Further discussion of INWARS outputs will be found in Volume IV of this User's Manual.

B. PHYSICAL STATE SNAPSHOTS

Physical state snapshots represent the "true" state of the simulation at a given point in time. They are taken periodically over the course of the simulation and provide information about each force element in the simulation at that time. Organized on a force-element-by-force-element basis, these outputs include disposition information (hex location, facing, direction and speed of movement), strength information (aggregate strength as well as detailed breakout by asset type), and operational status information (mission, objective, current operation, axis, sector width, and nuclear/chemical readiness). The form and content of these output information elements is described in the User's Manual, Volume IV, Chapter II.

C. C^2I ELEMENT UOS SNAPSHOTS

UOS snapshots give the user access to each EAD C^2I Element's Understanding of the Situation (UOS). These snapshots may or may not correspond to the "true" physical state snapshots due to EAD C^2I elements' imperfect perceptions and/or time delays in receiving current situation information.

Nonetheless, they are the basis upon which the EAD C^2I elements are conducting their operations at the time of the snapshot. Like physical state snapshots, UOS snapshots are taken periodically over the course of the simulation for all EAD C^2I elements; in addition, limited UOS snapshots are taken for individual EAD C^2I elements at key decision points. As is described in the User's Manual, Volume IV, these snapshots may include Situation Data (Own Status, Enemy Order of Battle/Target, and Situation Features Information) and Operations Data (Operative Operation Directive, Operative Concept of Operation, Progress Management, Weapons Management, and Readiness Management information). In addition, temporary Weapons Employment Plans may be output if they are to be "acted on" as a part of Weapons Employment activities.